

providing a second premixed source reagent solution comprising a second mixture of the lead precursor, the titanium precursor and the zirconium precursor in the solvent medium, wherein the first source reagent mixture is different from the second source reagent mixture;

A²

mixing the first and second reagent solutions to form a precursor solution;

vaporizing the precursor solution to form a precursor vapor; and

introducing the precursor vapor into a chemical vapor deposition chamber containing the substrate.

A³

23. (Amended) A method of forming a ferroelectric PZT film on a substrate, comprising:

introducing a substrate into a chemical vapor deposition chamber;

preheating the substrate during a preheating period;

after the preheating period, disposing the substrate on a heated susceptor during a heating period;

metering from a liquid source a selected quantity of a premixed liquid source reagent solution comprising a mixture of a lead precursor, a titanium precursor and a zirconium precursor in a solvent medium;

vaporizing the metered source reagent solution to form a precursor vapor; and

introducing the precursor vapor into the chemical vapor deposition chamber to form a ferroelectric PZT film on the heated substrate.

A⁴

Please add the following new claims.

26. The method of claim 23, further comprising metering from a second liquid source a selected quantity of a second premixed liquid source reagent solution comprising a second mixture of the lead precursor, the titanium precursor and the zirconium precursor in the solvent medium, wherein the first source reagent mixture is different from the second source reagent mixture.

27. The method of claim 26, further comprising mixing the first and second premixed liquid source reagent solutions to form a precursor mixture and, subsequently, vaporizing the precursor mixture to form the precursor vapor.

Amend

28. The method of claim 26, wherein the first and second source reagent solutions are characterized by a lead concentration in a range of about 28-65%, a zirconium concentration in a range of about 14-29%, and a titanium concentration in a range of about 20-43%.

COMMENTS

I. Status of claims

Claims 1-25 were pending.

Claims 1 and 23 have been amended.

Claims 26-28 have been added.

II. Allowable claims

Claim 9 has been rewritten in independent form in response to the Examiner's indication that such an amendment would place claim 9 in condition for allowance.

Claim 10 depends from claim 9 and, therefore, should be allowed for at least the same reasons.

III. Claim rejections under 35 U.S.C. § 102(e)

A. Claim rejections over WO 00/49646

The Examiner has rejected claims 1-8 and 11-18 under 35 U.S.C. § 102(e) over WO 00/49646. Claim 1 is an independent claim. Claims 2-8 and 11-18 depend from claim 1.

Independent claim 1 has been amended and now recites the step of "metering from a liquid source a selected quantity of a premixed liquid source reagent solution comprising a mixture of a lead precursor, a titanium precursor and a zirconium precursor in a solvent medium." In the PZT film forming methods disclosed in WO 00/49646, the precursors of the component metals are introduced into the deposition system from separate, respective liquid

sources; the precursors of the component metals are not premixed into a liquid source reagent solution that is metered from a liquid source. For example, WO 00/49646 teaches that “the metalorganic precursors of the desired $PbZr_xTi_{1-x}O_3$ film are introduced in liquid form, either as neat liquids or dilute solutions if the precursor is a liquid at ambient temperature and pressure ... conditions, or if the precursor composition is a solid at such ambient conditions, then as a solution of the precursor in a compatible solvent medium” (page 13, lines 4-8). After the component metal precursors have been introduced into the system, the different component metal precursors are formulated into a liquid precursor composition that is introduced into the vaporization zone (see, e.g., page 14, second full paragraph).

In sum, there is no teaching or suggestion in WO 00/49646 that would have led one of ordinary skill in the art at the time of the invention to meter from a liquid source a selected quantity of a premixed liquid source reagent solution comprising a mixture of a lead precursor, a titanium precursor and a zirconium precursor in a solvent medium, as recited in claim 1. For at least this reason, the Examiner’s rejection of independent claim 1 under 35 U.S.C. § 102(e) over WO 00/49646 now should be withdrawn.

Claims 2-8 and 11-18 incorporate the features of independent claim 1 and therefore are patentable for at least the same reasons.

B. Claim rejections over WO 99/42282

The Examiner has rejected claims 1-8 and 12-18 under 35 U.S.C. § 102(e) over WO 99/42282. Claim 1 is an independent claim. Claims 2-8 and 12-18 depend from claim 1.

Independent claim 1 has been amended and now recites the step of “metering from a liquid source a selected quantity of a premixed liquid source reagent solution comprising a mixture of a lead precursor, a titanium precursor and a zirconium precursor in a solvent medium.” In the PZT film forming methods disclosed in WO 99/42282, the precursors of the component metals are introduced into the deposition system from separate, respective liquid sources; the precursors of the component metals are not premixed into a liquid source reagent solution that is metered from a liquid source. For example, WO 99/42282 teaches that (page 22, second full paragraph; emphasis added):

Figure 3 is a schematic representation of a liquid delivery system 60 for simultaneous, controlled introduction of

metalorganic compounds to a CVD reactor. The metalorganic compounds are in respective liquid solutions in reservoirs 50, 52 and 54 which are manifolded together by manifold 56 joined in liquid flow communication with liquid precursor stream feed line 58. From feed line 58, the precursor stream is flowed under the action of pump 68 through line 70 to the vaporization zone 72.

FIG. 3 clearly shows that the component metal precursors are metered from separate respective liquid reservoirs 50, 52, 54. Accordingly, WO 99/42282 fails to teach or suggest the step of metering from a liquid source a premixed liquid source reagent solution comprising a mixture of a lead precursor, a titanium precursor and a zirconium precursor in a solvent medium, as recited in claim 1.

For at least these reasons, the Examiner's rejection of independent claim 1 under 35 U.S.C. § 102(e) over WO 99/42282 now should be withdrawn.

Claims 2-8 and 12-18 incorporate the features of independent claim 1 and therefore are patentable for at least the same reasons.

IV. Claim rejections under 35 U.S.C. § 103(a)

A. Claim 11

The Examiner has rejected claim 11 under 35 U.S.C. § 103(a) over WO 99/42282 in view of WO 99/00/49646.

Claim 11, however, incorporates the features of independent claim 1 and therefore is patentable for at least the same reasons explained above.

B. Claims 19-21, 23, and 24

The Examiner has rejected claims 19-21, 23, and 24 under 35 U.S.C. § 103(a) over either WO 99/42282 or WO 00/49646 in view of Horie (U.S. 6,387,182).

Claims 19 and 20 depend from independent claim 1. Horie does not make up for the failure of WO 99/42282 and WO 00/49646, taken alone or in any permissible combination, to teach or suggest the features of independent claim 1 discussed above. For at least this reason,

the Examiner's rejection of claims 19 and 20 under 35 U.S.C. § 103(a) over either WO 99/42282 or WO 00/49646 in view of Horie should be withdrawn.

Independent claim 23 has been amended and now recites the step of metering from a liquid source a selected quantity of a premixed liquid source reagent solution comprising a mixture of a lead precursor, a titanium precursor and a zirconium precursor in a solvent medium. As explained above in connection with independent claim 1, neither WO 99/42282 nor WO 00/49646 teaches or suggests such a step. For at least this reason, the Examiner's rejection of claim 23 under 35 U.S.C. § 103(a) over either WO 99/42282 or WO 00/49646 in view of Horie should be withdrawn.

Claim 24 incorporates the features of independent claim 23 and therefore is patentable for at least the same reasons.

C. Claim 22

The Examiner has rejected claim 22 under 35 U.S.C. § 103(a) over either WO 99/42282 or WO 00/49646 in view of Yamamuka (U.S. 6,312,526).

Claim 22 depends from independent claim 23. Yamamuka does not make up for the failure of WO 99/42282 and WO 00/49646, taken alone or in any permissible combination, to teach or suggest the features of independent claim 23 discussed above. For at least this reason, the Examiner's rejection of claim 22 under 35 U.S.C. § 103(a) over either WO 99/42282 or WO 00/49646 in view of Yamamuka should be withdrawn.

D. Claim 25

The Examiner has rejected claim 25 under 35 U.S.C. § 103(a) over either WO 99/42282 or WO 00/49646 in view of Horie and Yamamuka.

Claim 25 depends from independent claim 23. Neither Horie nor Yamamuka, taken alone or in any permissible combination, make up for the failure of WO 99/42282 and WO 00/49646, taken alone or in any permissible combination, to teach or suggest the features of independent claim 23 discussed above. For at least this reason, the Examiner's rejection of claim 25 under 35 U.S.C. § 103(a) over either WO 99/42282 or WO 00/49646 in view of Horie and Yamamuka should be withdrawn.

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V. New claims

New claims 26-28 incorporate the features of independent claim 23 and, therefore, these claims are patentable for at least the same reasons explained above.

VI. Conclusion

For the reasons explained above, all of the pending claims are now in condition for allowance and should be allowed.

Charge any excess fees or apply any credits to Deposit Account No. 50-1078.

Respectfully submitted,

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APPENDIX

Marked-up versions of the claimed amended by the Response filed July 7, 2003, are presented below.

In the claims:

1. (Amended) A method of forming a ferroelectric PZT film on a substrate, comprising:

[providing] metering from a liquid source a selected quantity of a premixed liquid source reagent solution comprising a mixture of a lead precursor, a titanium precursor and a zirconium precursor in a solvent medium;

vaporizing the metered source reagent solution to form a precursor vapor; and

introducing the precursor vapor into a chemical vapor deposition chamber containing the substrate.

9. (Amended) The method of claim 1, further comprising:

providing a first premixed source reagent solution comprising a mixture of a lead precursor, a titanium precursor and a zirconium precursor in a solvent medium;

providing a second premixed source reagent solution comprising a second mixture of the lead precursor, the titanium precursor and the zirconium precursor in the solvent medium, wherein the first source reagent mixture is different from the second source reagent mixture;

mixing the first and second reagent solutions to form a precursor solution; [and]

vaporizing the precursor solution to form a [the] precursor vapor; and

introducing the precursor vapor into a chemical vapor deposition chamber containing the substrate.

23. (Amended) A method of forming a ferroelectric PZT film on a substrate, comprising:

introducing a substrate into a chemical vapor deposition chamber;

preheating the substrate during a preheating period;

after the preheating period, disposing the substrate on a heated susceptor during a heating period;

metering from a liquid source a selected quantity of a premixed liquid source reagent solution comprising [forming a precursor solution from] a mixture of a lead precursor, a titanium precursor and a zirconium precursor in a solvent medium;

vaporizing the metered source reagent [precursor] solution to form a precursor vapor; and

introducing the precursor vapor into the chemical vapor deposition chamber to form a ferroelectric PZT film on the heated substrate.